

Emerging Per- and Polyfluoroalkyl Substances (PFAS)

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Northeastern University
*Social Science Environmental Health
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Highly Fluorinated Compounds
Social and Scientific Discovery
Northeastern University Social Science
Environmental Health Research Institute
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Overview

- Sources and exposure pathways of legacy PFAS (PFOS & PFOA) somewhat known
- USEPA's Stewardship Program has reduced legacy PFAS but has also resulted in the development of many new "emerging" PFAS
- New analytical capabilities (high resolution mass spectrometry) allow detection of many new PFAS
- Emerging PFAS almost completely uncharacterized with regard to sources, environmental fate, human exposure implications
- Discussion of some recent research on sources of emerging PFAS, human exposure pathways, overall implications

US Environmental Protection Agency

PFOA Stewardship Program

In January 2006, USEPA started this program to help minimize impact of PFOA in the environment

Eight major international companies have agreed to participate (including 3M, DuPont, Asahi Glass, Daikin)

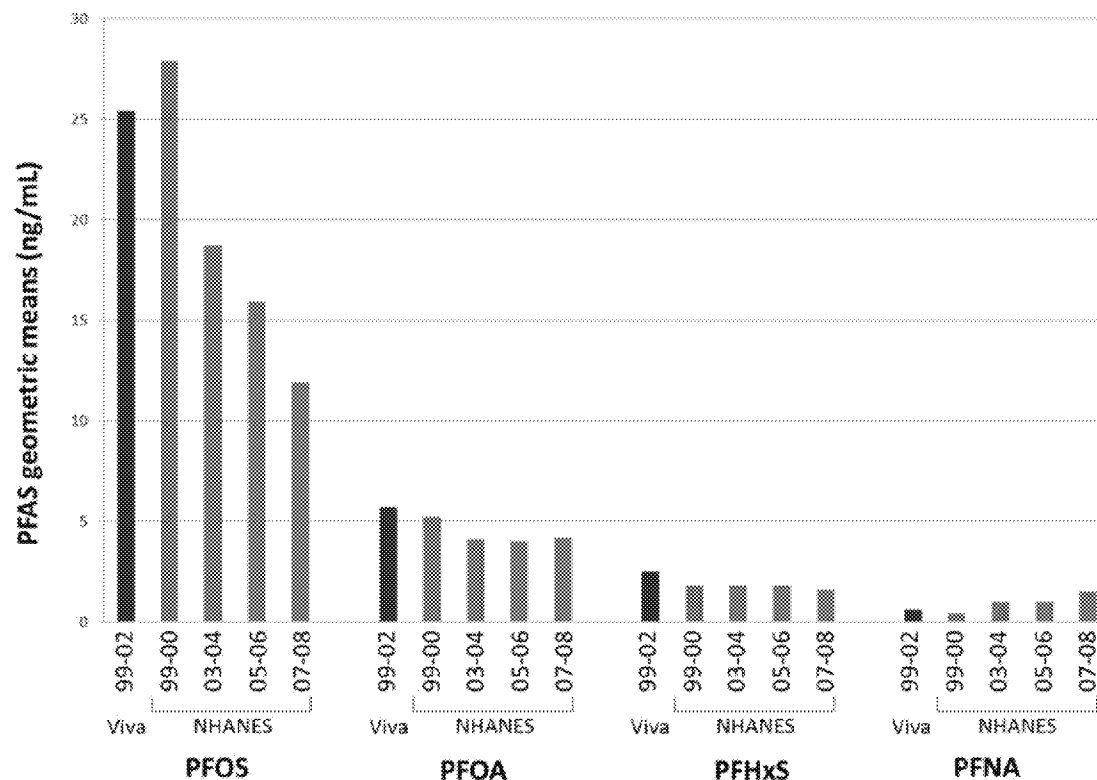
Agreement to voluntarily reduce factory emissions and product content of PFOA and related compounds* on a global basis by 95% no later than 2010

Agreement to work toward total elimination of emissions and product content of these compounds by 2015

Based on emissions and content determinations made for 2006

* Includes PFOA, precursor chemicals that can break down to PFOA, higher homologues (C9 and larger)

Trends in PFAS Serum Levels in US



Sagiv et al. *Environmental Science & Technology* 2015, 49, 11849–11858

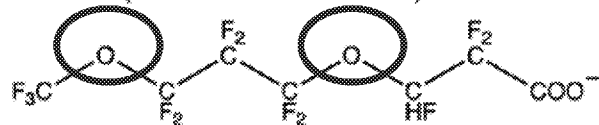
Table 2. Geometric mean and 95% confidence interval and selected percentiles of PFOS, PFOA, PFHxS, and PFNA serum concentrations (ng/mL) for the U.S. population 12 years of age and older: Data from NHANES 2011-2012 ^a

	Geometric Mean (95% Confidence Interval)		Selected Percentiles			
			50 th	75 th	90 th	95 th
PFHxS	1.28	1.15-1.43	1.27	2.26	3.81	5.43
PFOS	6.31	5.83-6.82	6.51	10.48	15.62	21.68
PFOA	2.08	1.95-2.22	2.08	3.02	4.35	5.67
PFNA	0.88	0.80-0.97	0.86	1.30	1.95	2.54

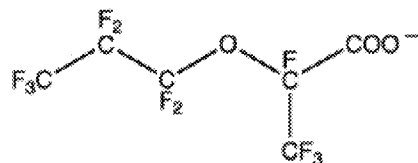
^a CDC (2015)

Fluoropolymer manufacture

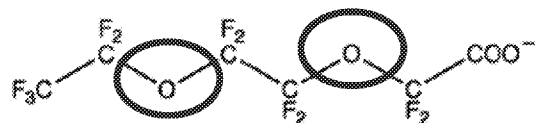
ADONA (CAS No. 958445-44-8)



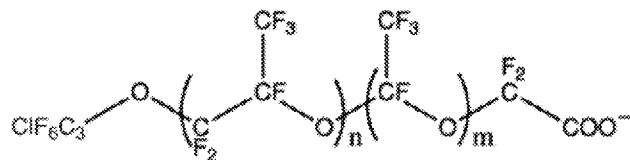
GenX (CAS No. 62037-80-3)



Asahi's product (CAS No. 908020-52-0)

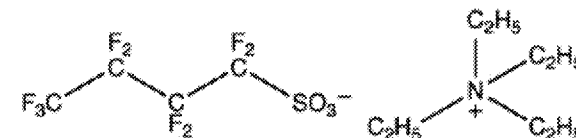


Solvay's product (CAS No. 329238-24-6)

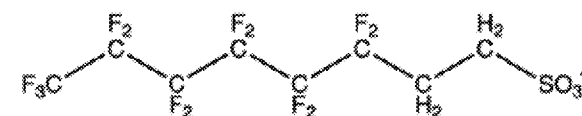


Metal plating

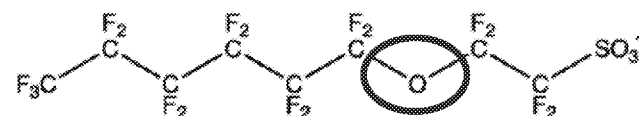
N(Et)₄-PFBS (CAS No. 25628-08-4)



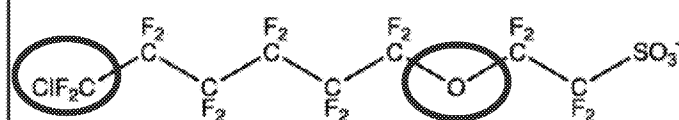
6:2 FTSA (CAS No. 27619-97-2)



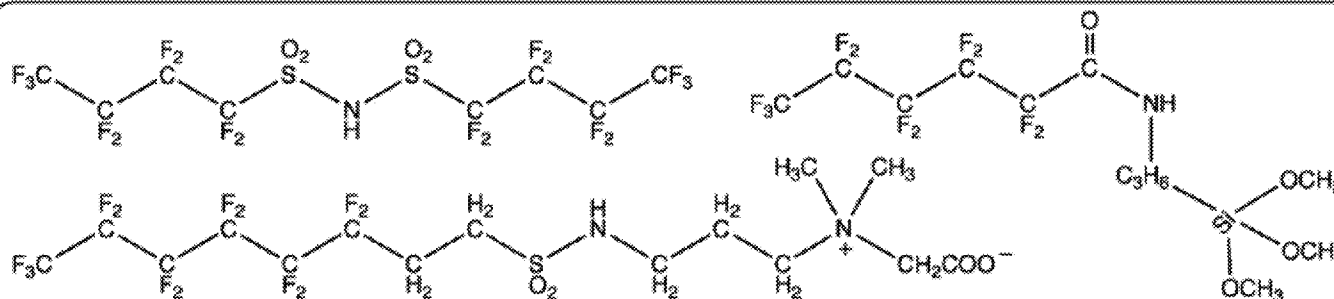
F-53 (CAS No. 754925-54-7)



F-53B (CAS No. 73606-19-6)



Fire fighting foams and miscellaneous

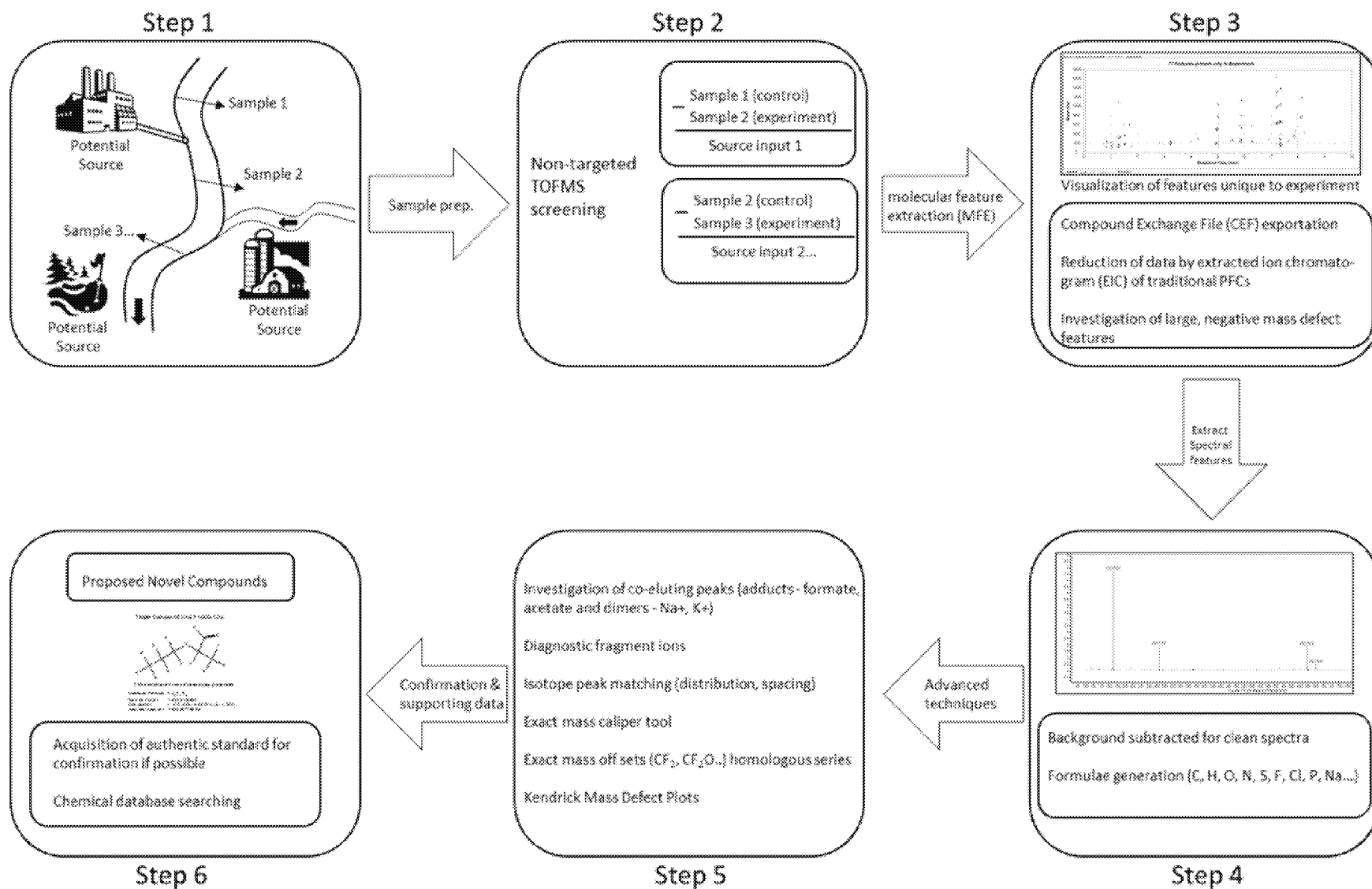


Unknown characteristics of “emerging” fluorinated compounds

- Actual identities of alternatives unknown in industrial sectors and geographical regions that are not well regulated
- Data on environmental and human health effects are incomplete (at best) and more often nonexistent
- Data on degradability, bioaccumulation, and toxicity (environmental and human) are incomplete (at best) or completely lacking
- Information on production volume and environmental emissions not available

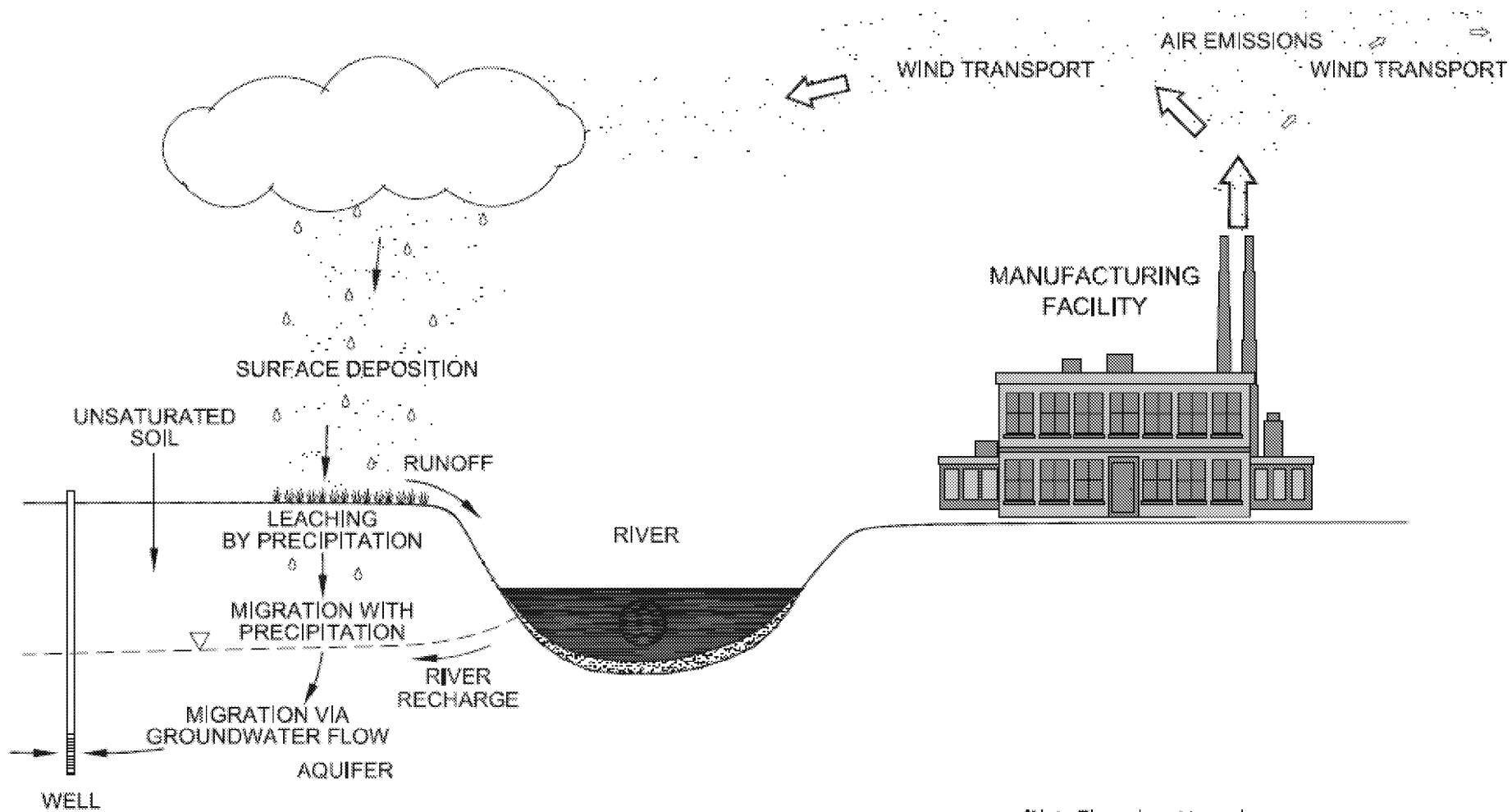
Z. Wang et al. / Environment International 60 (2013) 242–248

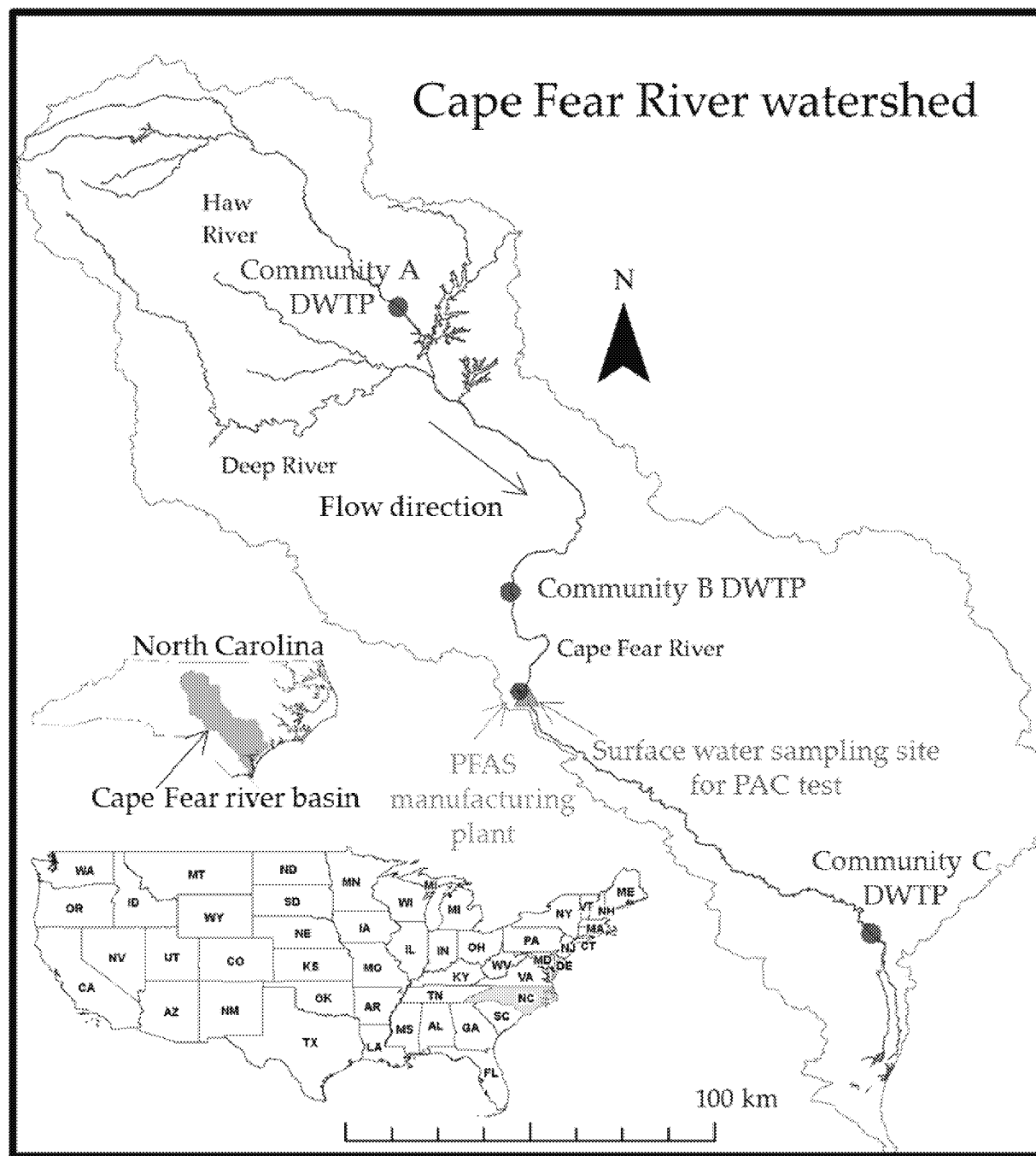
High resolution mass spectrometry to find “emerging” PFAS



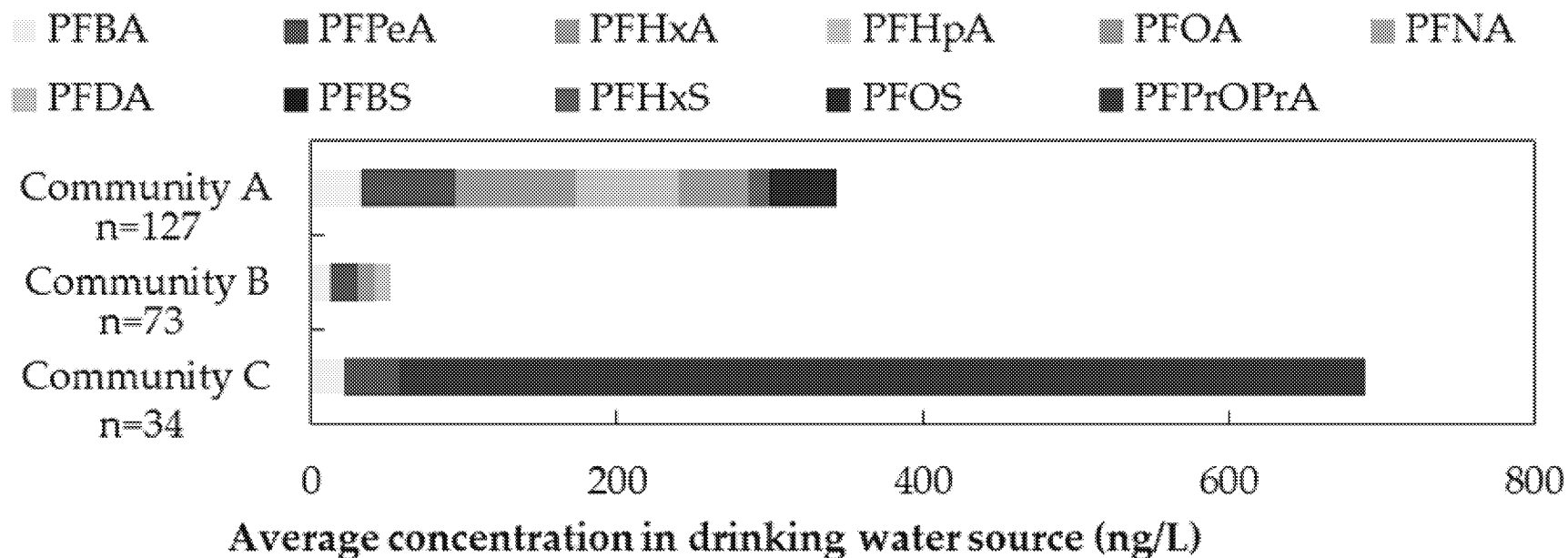
WELL FIELD

SITE



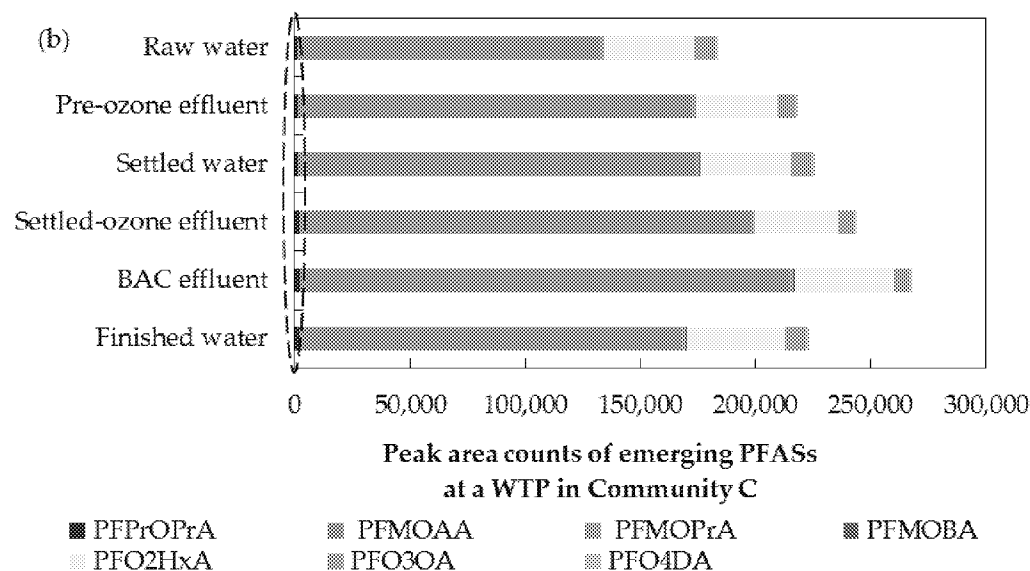
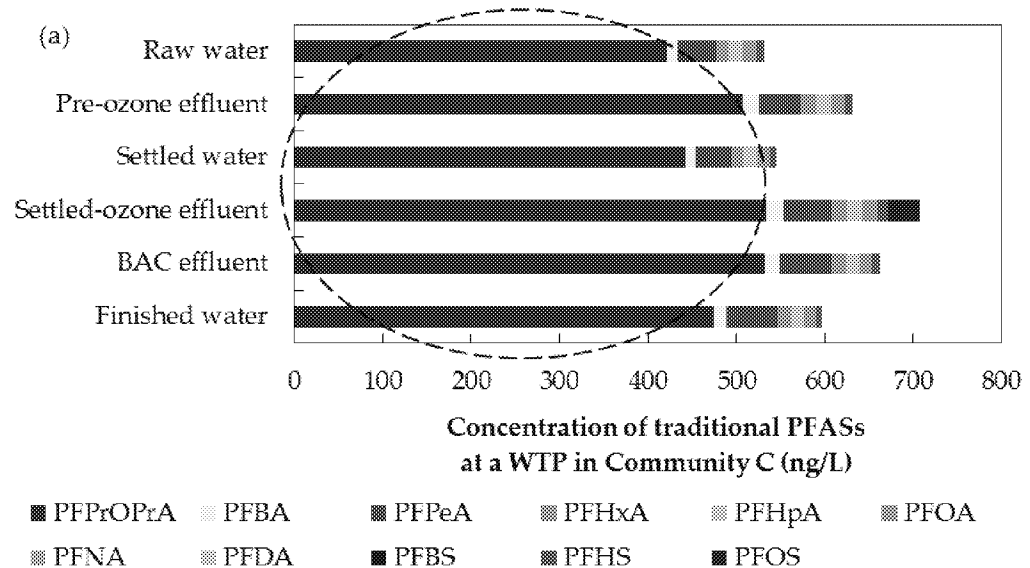


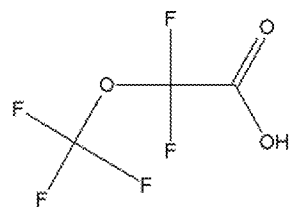
Legacy PFAS with GenX in Cape Fear River Basin



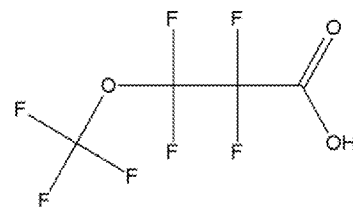
Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415–419

Emerging PFAS in Cape Fear River Basin

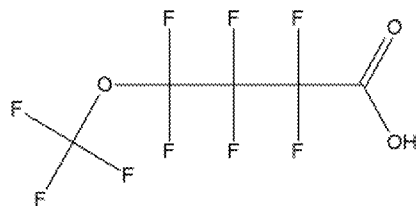




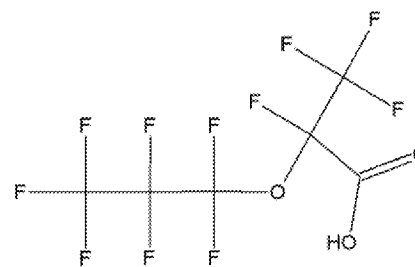
PFMOAA



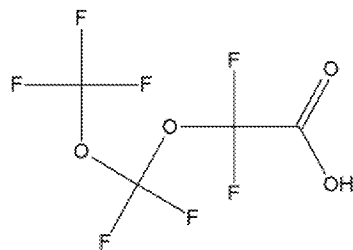
PFMOPrA



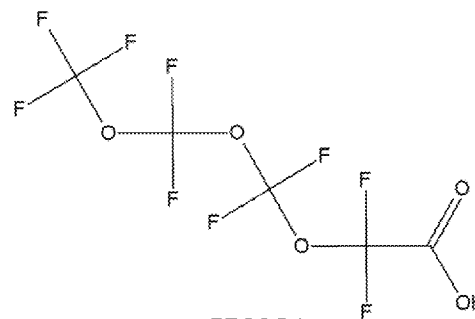
PFMOBA



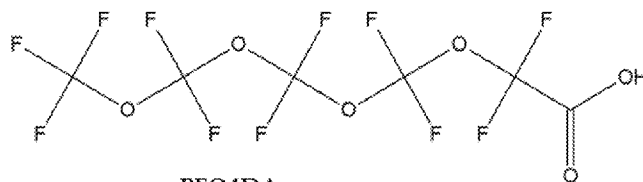
PFPrOPrA



PFO2HxA



PFO3OA



PFO4DA

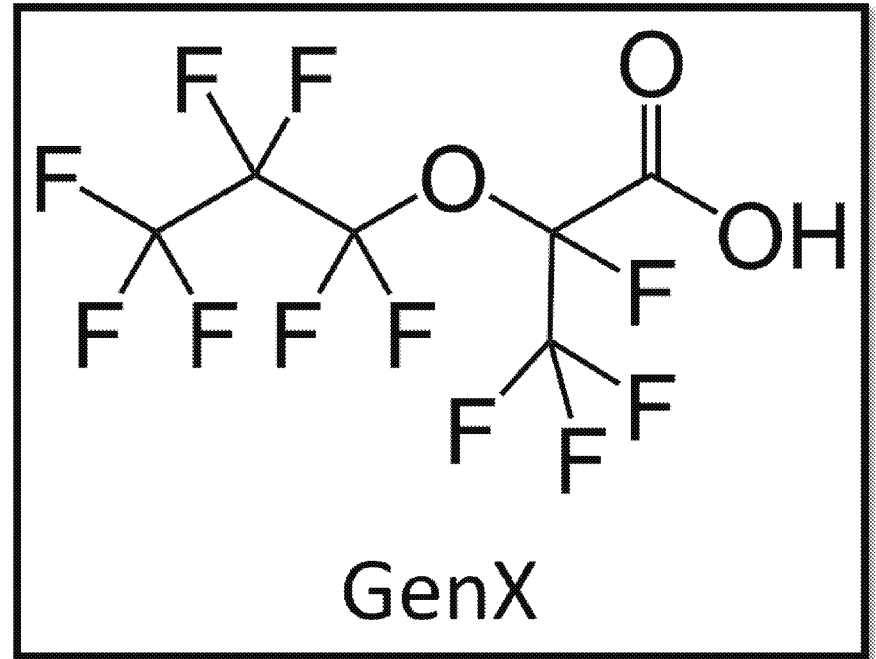
GenX

Identity originally protected
as Confidential Business
Information (CBI)

Still persistent, still toxic, but
less bioaccumulative than C8

DuPont studies found effects
on rats similar to C8, including
possible endocrine/immune
disruption, enlarged livers and kidneys,
and cancer

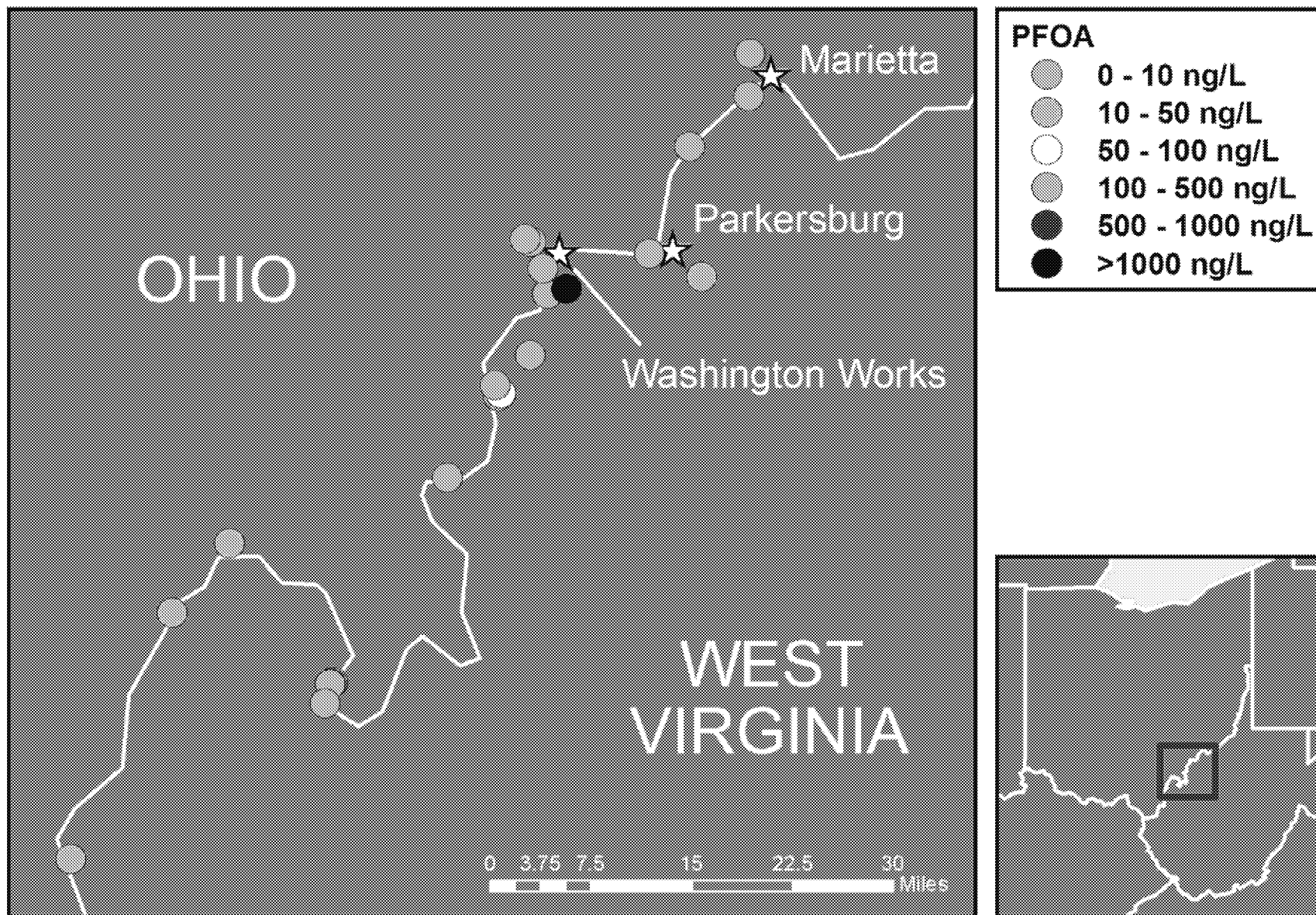
Approved by the EPA, no further testing
required



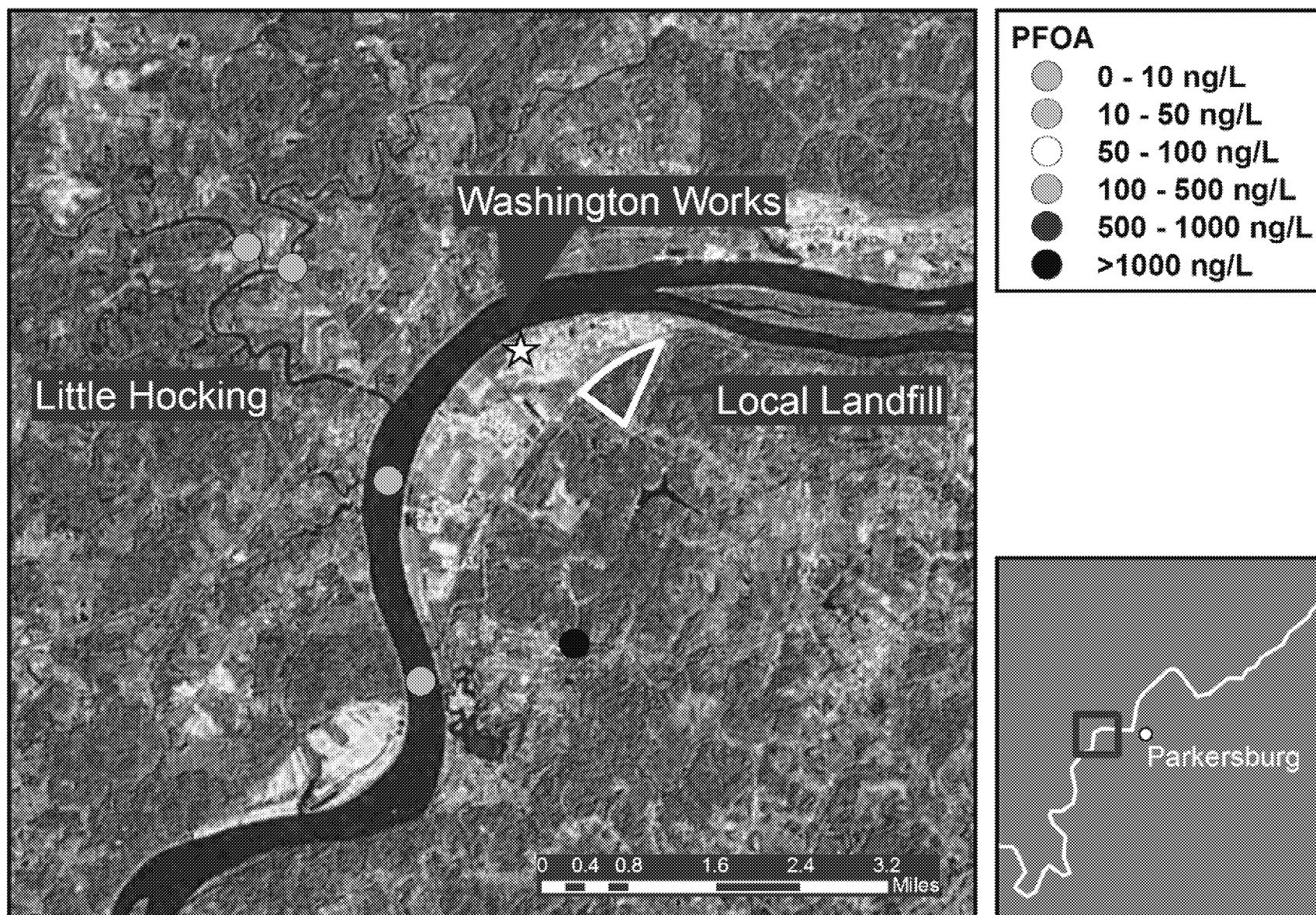
Trip #1 – Ohio River



Ohio River Results

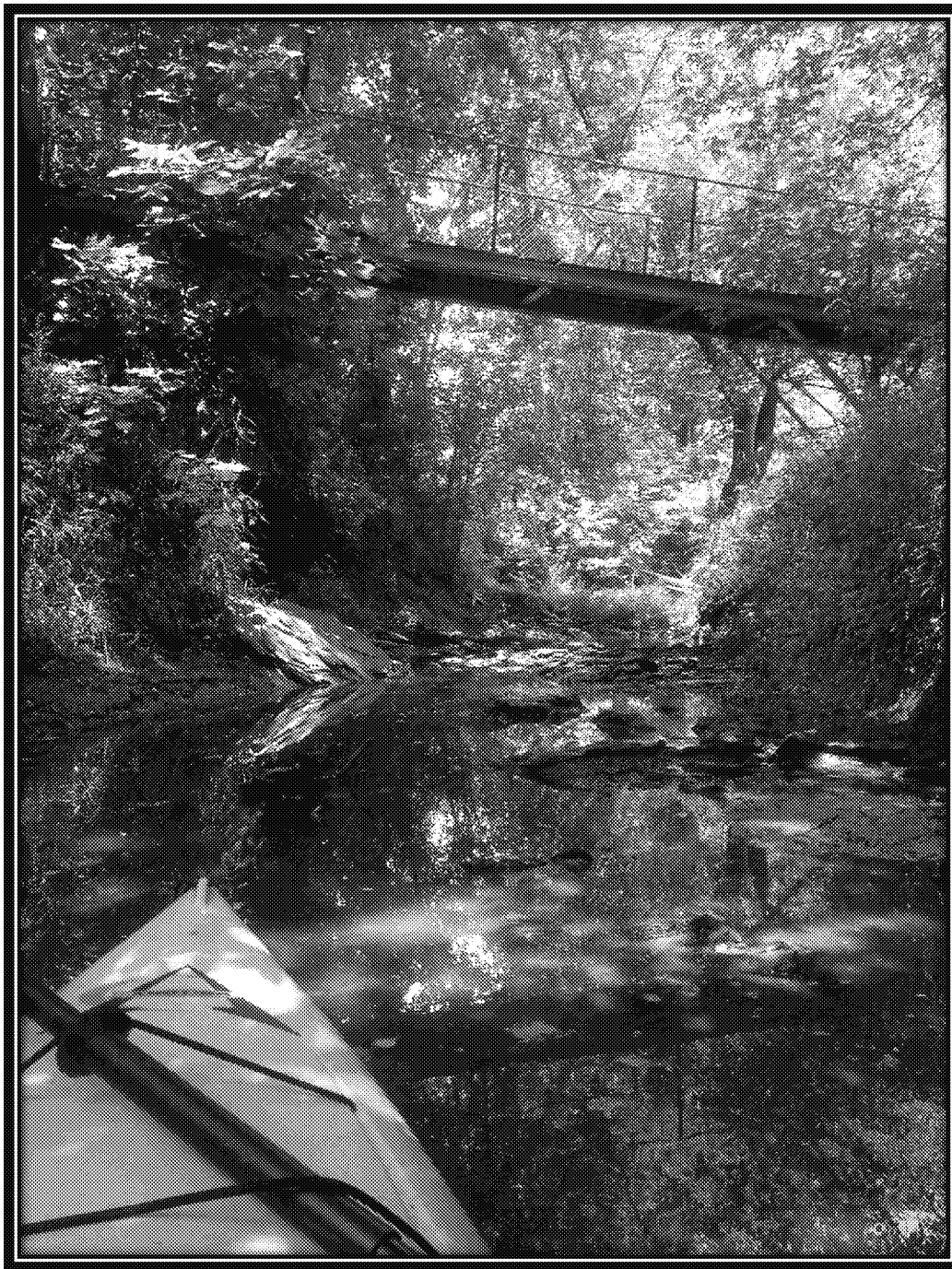


Ohio River Results (Detail)

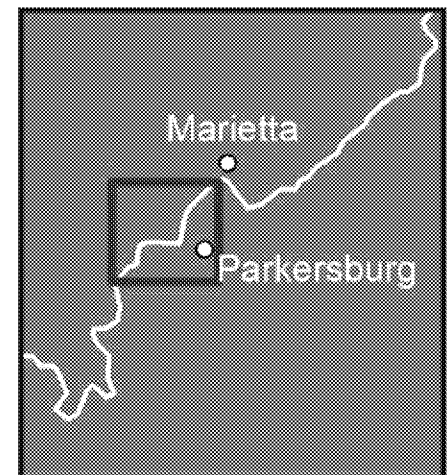
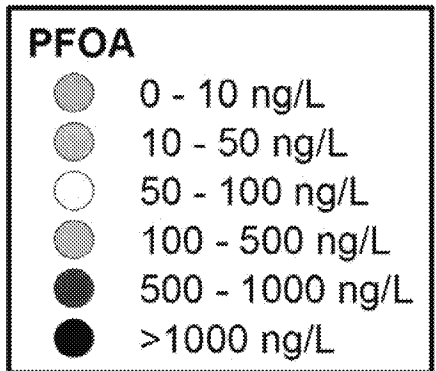
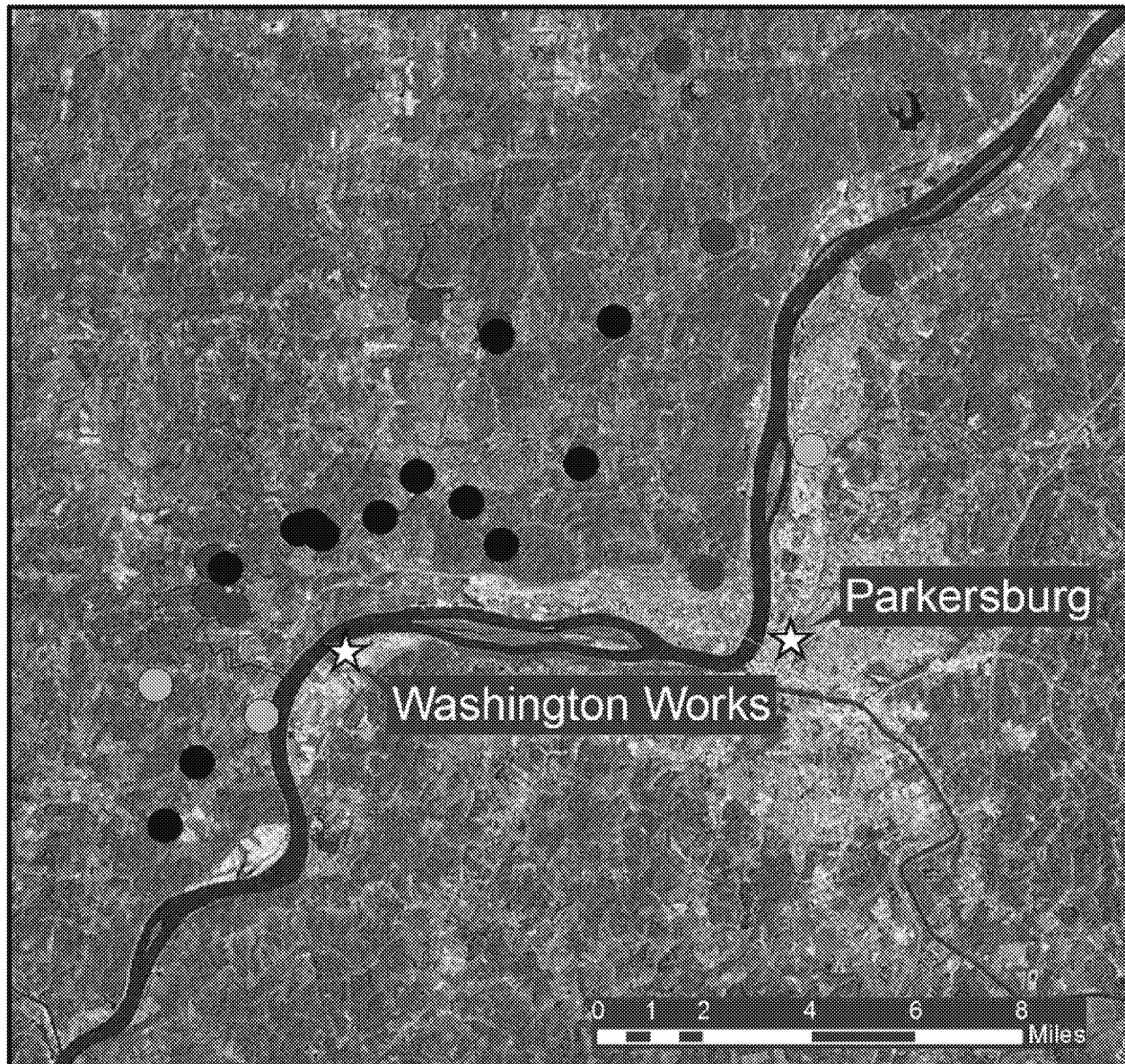


Trip #2 – Little Hocking River





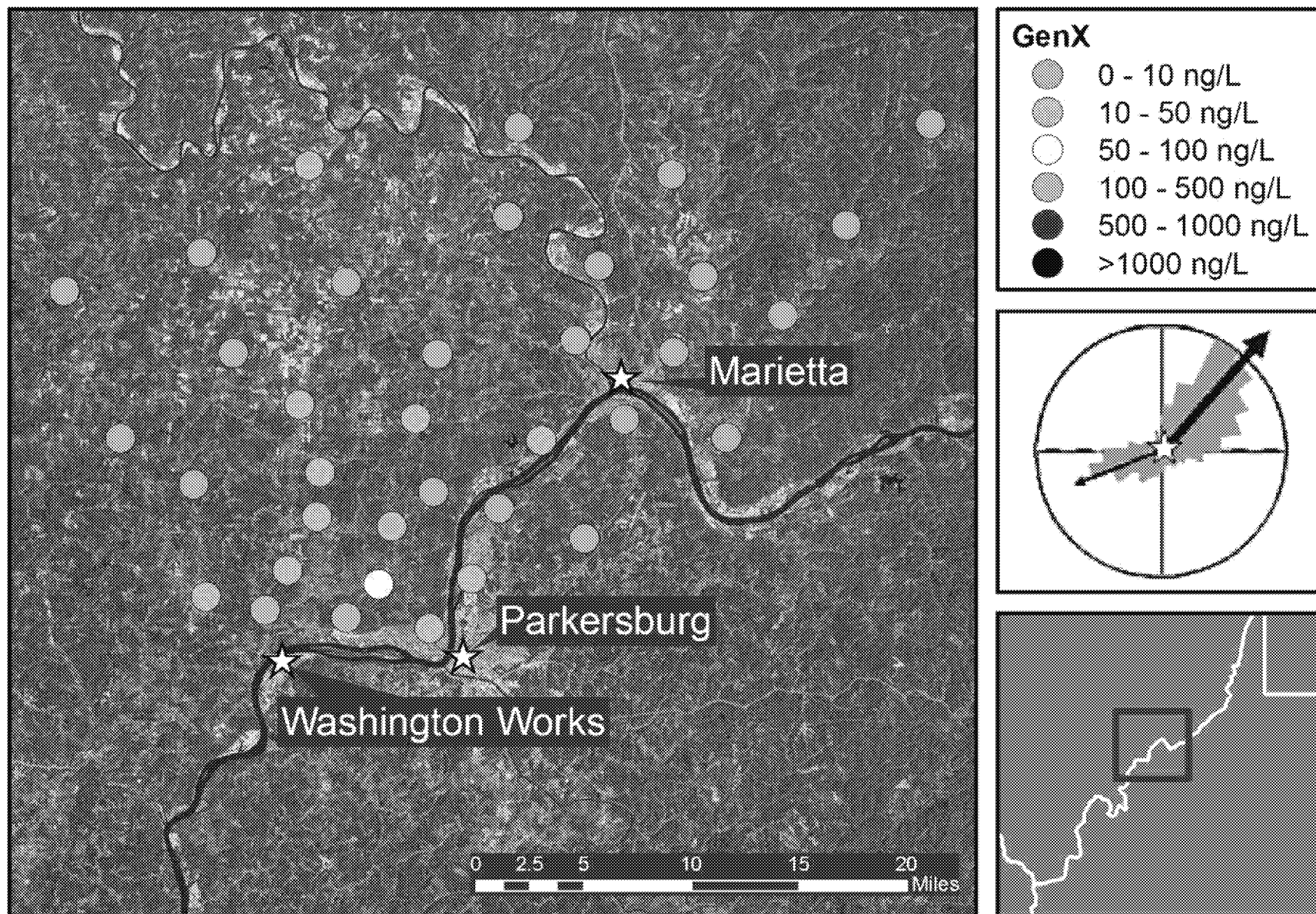
Little Hocking Results



Trip #3 – Little Hocking and Beyond



Extended Sampling Results



Conclusions

- The presence of significant levels of PFOA (>100 ng/L) in surface water more than 15 miles from the facility and quantifiable levels (>10 ng/L) more than 25 miles away suggest local contamination may be more extensive than originally thought.
- The discovery of GenX at many of the collection sites suggests the replacement PFAS is contaminating the local environment via air deposition as well.
- More testing is needed – especially private well water between the historic testing area and the Muskingum River.

Questions?

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